Checkout and Launch Control System

Redstone Delivery Document

May 19, 1997
Final Release

Signature Page

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Change Page

Release	Date	Subjects
Final	5/19/97	Incorporated Concept Design Panel Updates
2	3/3/97	Updated System Software Matrix Revised thread descriptions and Statement of Work(s)

Delivery Overview:

The Redstone Delivery is scheduled for completion on September 26, 1997. It is the second incremental delivery of the CLCS Project. The Redstone delivery consists of hardware, software, and facility products that will support the continuing CLCS development. Functional products will be delivered to provide the foundation for the CLCS hardware and software architecture. In addition, significant initial Application Services and System Services will be provided to support CLCS application development.

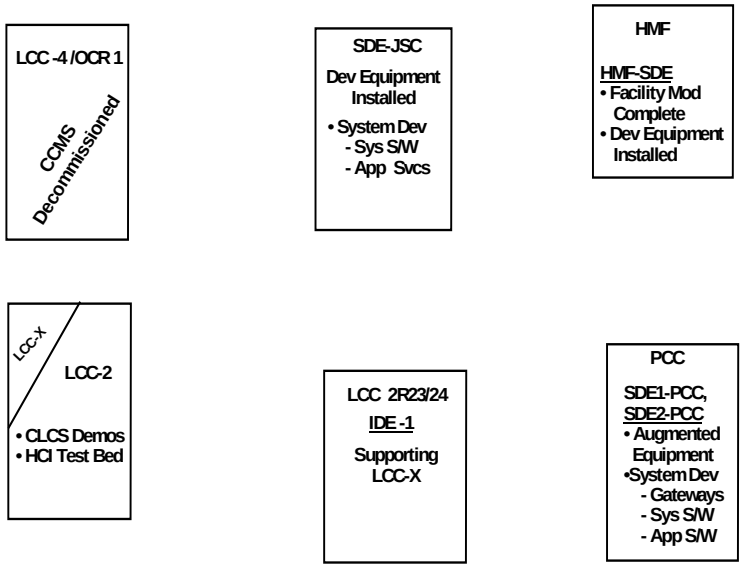
The Redstone delivery will produce 4 system capabilities:

- Super Light Weight Tanking Test Support: Provides the capability to monitor real time pre-launch and launch measurements for the Space Shuttle's third-generation tank. This support will be provided in the LCC-X
- GSE Data Link Support (Command and Monitor): Provides the initial capability to command and monitor the GSE FDs.
- CLCS Application Development/Debug/Integration Foundation: Establishes the capability to debug user applications in a standalone environment.
- HMF Pathfinder S/W: Demonstrates a first look at the new Hypergolic Maintenance facility console screens which will eventually be used to command and control HMF Ground Support Equipment. This S/W will be housed in Redstone prototype consoles.

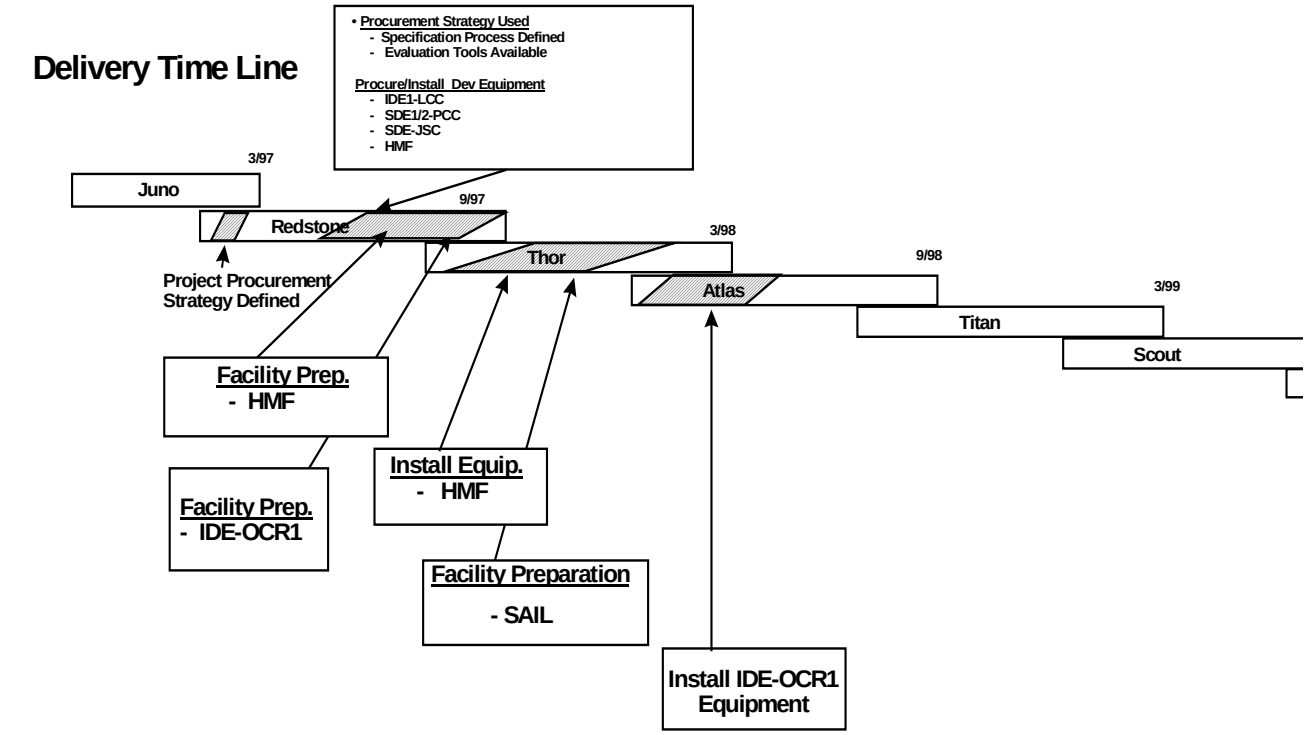
The following illustrates all the CLCS sites at the Redstone delivery.

CLCS Post Redstone Topography

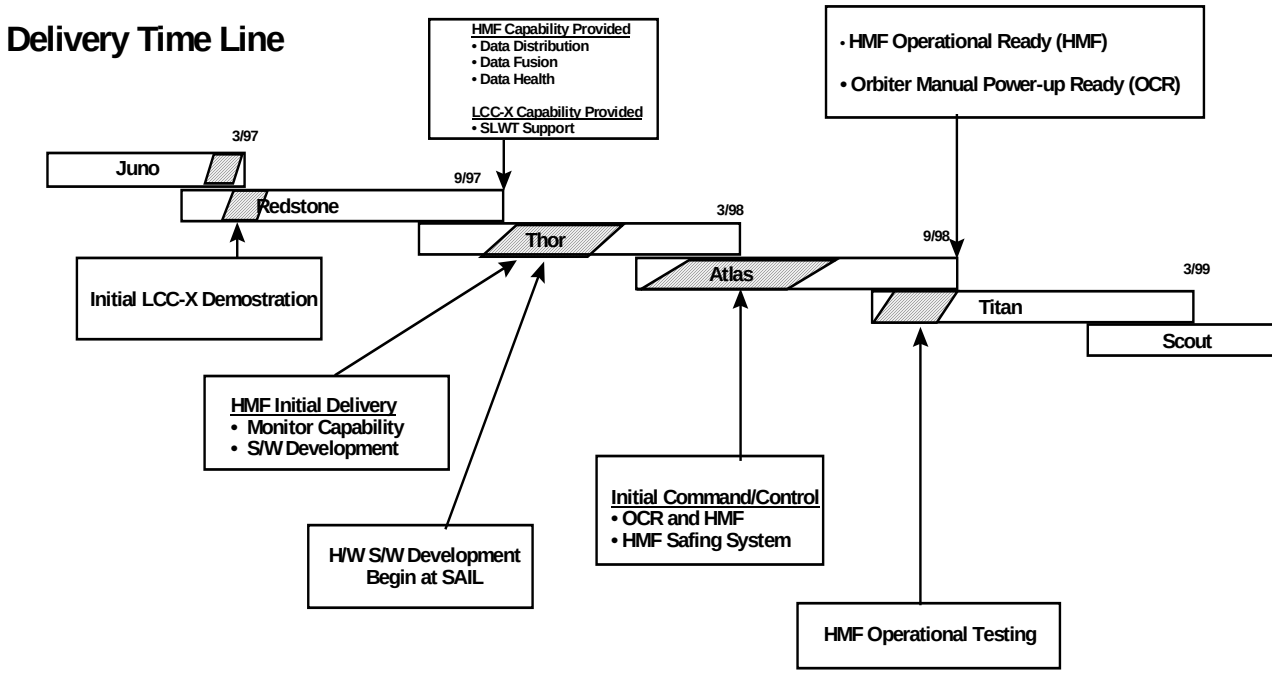
Facilities



High Level Schedule
Facility and Procurement



High Level Schedule
Capability



1.0 Facilities - Control Rooms and Development Environments

1.1 OCR 1 - LCC

Overview - An Integrated Development Environment at the LCC for System Software and Application Software Development

1.1.1 Facilities

- Renovated LCC-4/3R22 Facility Ready for CLCS Equipment Installation including:
- Implemented Facility Modification Driven Human Factors Requirements
- Generic Power Grid To Support Console Layouts
- Known COMM Connectivity

1.1.2 HWCIs:

- None

1.2 OCR - HMF

Overview - The Hypergolic Maintenance Facility Control Room.

1.2.1 Facilities

- Design HMF control room.
- Demolition of existing space; rooms 103, 105, 105A.
- Installation of raised floor.

1.2.2 HWCIs

Quantity	Part Number	Product Type
1	ASX-1000-5AC- ATM Switch	RTCN HWCI
1	ASX-1000-5AC- ATM Switch	DCN HWCI
	TBP (from ttl 70) SGI O2	HCI Dev w/s HWCIs
1	SGI Origin 2000	Data Distribution Processor HWCI
1	SGI Origin 2000	Command and Control Processor HWCI
2	TBP	Black/White Laser Printers
1	TBP	Color Laser Printer
5	TBP	Single Position Console Enclosures (Redstone Class)
1	Sun Ultrasparc W/S	Gateway Development W/S
1	TBP	Network Time Processor
1 (from ttl 70)	SGI O2	Boot Server
1 (from ttl 70)	SGI O2	Time and NIS Server

Redstone Class Gateway HWCIs

4	TBD	CLCS GSE Gateway
2	TBD	Prototype VHM/OMS Gateway

1.3 IDE 1-LCC

Overview - An Integrated Development Environment for System Software and Application Software Integrated Testing and Operational Deployment Preparation

1.3.1 Facilities

- LCC Room 2R23/24 Prepped for integrated system level testing Including:
- COMM Consumable
- Gateway Data Links
- Simulation Data Links
- Connectivity to LCC-X HCI

1.3.2 HWCIs

Quantity	Part Number	Product Type
1	ASX-1000-5AC- ATM Switch	RTCN HWCI
1	ASX-1000-5AC- ATM Switch	DCN HWCI
2 (from ttl 70)	SGI O2	HCI Dev w/s HWCIs
1	SGI Origin 2000	Data Distribution Processor HWCI
2	SGI Origin 2000	Command and Control Processor HWCI
2	TBP	Black/White Laser Printers
1	TBP	Color Laser Printer
1	TBP	Edge Device - ATM to Ethernet
Redstone Class Gateway HWCIs		
1	TBD	CLCS GSE Gateway
1	TBD	CLCS Cons. Sys Gateway
2	TBD	CLCS PCM D/L Gateway
1	TBD	CLCS LDB Gateway

1.4 SDE-JSC

Overview - A Satellite Development Environment at JSC/LMMSS for System Software and Application Software Development

1.4.1 Facilities

- None

1.4.2 HWCIs

Quantity	Part Number	Product Type
1	ASX-1000-5AC- ATM Switch	RTCN HWCI
1	ASX-1000-5AC- ATM Switch	DCN HWCI
9 (from ttl 70)	SGI O2	HCI Dev w/s HWCIs
1	SGI Origin 2000	Data Distribution Processor HWCI
2	TBP	Black/White Laser Printers
1	TBP	Color Laser Printer
1	TBP	Edge Device - ATM to Ethernet
1 (from ttl 70)	SGI O2	Support Server
1	TBP	WinFrame Server
Redstone Class Gateway HWCIs		
1	TBD	CLCS Cons. Sys Gateway
2	486 PC	

1.5 SDE 1-PCC

Overview - Augmentation of existing hardware in the SDE1-PCC to support hardware, system software, and application development in either a single or dual string configuration. The augmented hardware from the Juno delivery includes:

1.5.1 Facilities

- None

1.5.2 HWCIs

Quantity	Part Number	Product Type
1	ASX-1000-5AC- ATM Switch	RTCN HWCI
1	ASX-1000-5AC- ATM Switch	DCN HWCI
6 (from 70 ttl)	SGI - O2	HCI Dev w/s HWCIs
4	Gateway PC NT Based	HCI Dev w/s HWCIs
2	TBP	Black/Whit Laser Printers
1	TBP	Color Laser Printer
Redstone Class Gateway HWCIs		
2	TBD	CLCS GSE Gateway
1	TBD	CLCS Cons. Sys Gateway
2	TBD	CLCS PCM D/L Gateway

1.6 SDE 2-PCC

Overview - Augmentation of existing hardware in the SDE2-PCC to support hardware, system software, and application development in a single string or dual string with no redundancy.

1.6.1 Facilities

- None

1.6.2 HWCIs

Quantity	Part Number	Product Type
1	ASX-1000-5AC- ATM Switch	RTCN HWCI
1	ASX-1000-5AC- ATM Switch	DCN HWCI
6 (from ttl 70)	SGI O2	HCI Dev w/s HWCIs
2	TBP	Black/Whit Laser Printers
1	TBP	Color Laser Printer
Redstone Class Gateway HWCIs		
2	TBD	CLCS GSE Gateway
1	TBD	CLCS Cons. Sys Gateway
2	TBD	CLCS PCM D/L Gateway

2.0 Products

2.1 General SDE Products

These products will be shared and distributed to the various SDEs as indicated by requirements capture.

Quantity	Part Name/No.	Product Type
70	SGI 02	Development Workstation
1	Auspex Server Upgrade	Development Environment Server for PCC
As Required	TBP	Communication Consumables: Fiber, Cable,
As Required	TBP	Developer Support Items: Chairs, Desks,

2.2 Console Enclosures

2.2.1 LCC-X Early Start Console Enclosures

Quantity	Product Type
2	Early Start Consoles

2.2.2 Prototype Console Enclosure (Delivered to SDE1-PCC and SDE2-PCC)

Quantity	Product Type
2	Prototype Console Enclosure
2	Prototype Command Panel (Programmable Function Panel Replacement)
2	Prototype Safeing Panel Concept
2	Prototype Support Module
2	Preliminary OTV Integration Module
2	Prototype Console Workstation Configuration Decision

2.2.3 General Console and HCI Products

Acquisition Strategy For Console Enclosure
Platform Workstation Decision
Platform Display Selection Complete

2.2 General Products (Redstone class)

Product Type	Description
HWCI	Power PC Gateway Development Platform
HWCI	Gateway Rack Elevation Drawings (Initial)
HWCI	LDB Interface Board
HWCI	GSE Interface Board
CSCI	Gateway Control Process System Manger
Document	CLCS SDS Operational Procedures Document
Document	CLCS SDS Gateway Validation/Certification Document

2.3 Specific Gateway Products

Product Type	Name
CSCI	Final Consolidated SDS Gateway Service
CSCI	Initial SDS Filter Service
CSCI	Consolidated Data Services - SLWT Support
CSCI	Initial PCM D/L Services

3.0 Pathfinders

3.1 Application Test-Bed Pathfinder

Overview - The Application Test-Bed Pathfinder establishes the capability to debug user applications in a standalone environment. This environment will support the execution of User Applications, CLCS System Applications and a User Math Model within a single HCI workstation. The System Build and Network Services are key to this thread. Emphasis should be placed on assuring the User Applications and the Test Build are not affected by the difference in configurations. The intent is to be logically equivalent, not to simulate performance.

Pathfinder Emphasis - Providing a desktop environment to develop applications and evaluate tools

Statement of Work

Phase 1 (Redstone) - Early start HMF thread application development support.

- Provide the CLCS Application Test-Bed, which combines the major CLCS Groups (DDP, CCP, HCI) into a single HCI workstation.
    - The Test Build and User Applications should not be affected by this configuration difference.
- Provide the minimal support required for the following User Applications to execute within the CLCS Application Test-Bed:
    - User Display
    - End Item Manager
    - Math Model
    - Data Fusion
    - Constraint Management
- Define and implement the Application Services API's for this phase. These may be minimized as necessary to support HMF early start.
- Provide the logical messaging System Services.
- Provide the set build and load services for the Minimal Configuration and the Application Test Bed Environment.
- Provide the conditional set build and load services for System Services.
- Provide additional Application and System Services required for the internal EI Model.
- Integrate the following COTS tools with the Application Services API's:
    - Display
    - EIM Monitoring/Control
    - Data Fusion Monitoring/Control
- Provide internal modeling capabilities.
    - Evaluate End Item (EI) Modeling Tools to be utilized internally.
    - Provide the modeling tool(s).
- As with all development environments, the Application Test-Bed will require an interface to the CM system.
- Provide an FD Design tool utility.

3.2 HMF Software Pathfinder

HMF Software Pathfinder provides a pathfinder opportunity to develop a generic application software set architecture and development process while developing software to support HMF operations. The application software will be a subset of the planned application set. The HMF Integrated Product Development Team will develop examples of all elements of application software based on the HMF Software Requirements Document. This includes the HCI Manager, SL displays, sequencer interfaces, the CCP Manager, End-Item Manager, Reactive Control Logic, and Sequencers. In addition, a UNIX Platform Math Model of the HMF system will be developed to support testing of command and control software prior to Simulation Gateway development.

APIs

Application program interfaces (APIs) are being developed which will support the functionality required in stages. The APIs are a layer between the application software and the underlying system software and network. It provides a common interface regardless of what is underneath. The first phase gives basic FD services such as set command and read data plus a little more. It will allow us to get started in software debug.. The minimal extent of these services may require that application programs be run stand-alone instead of in a structured set as is planned. This phase of the APIs should be available by July 1, 1997, possibly sooner.

The second phase provides the remainder of the services required to have a structured set. It provides many of the perform concurrently, communication and remote method invocation functionality that will be required to support the planned application set architecture. This phase is needed before the end of redstone, preferably much sooner.

The third phase provides services that will be needed before going to hardware but do not affect the overall set. These are generally services specific to a particular test or associated with system manipulation. This includes such items as data averaging and changing data characteristics such as sample rate. This phase is not needed for Redstone.

All API “deliveries” described here are non-verified software. They are simply to allow application software development. The verified APIs will be needed before the end of Thor to support application software verification. We would like to begin application software verification about 2/1/98.

Environment

This first phase of the APIs will not be on a distributed system. All of the application software will run in one box but will contain the same code as if it were distributed. This will allow software debug o begin as soon as possible.

However, we would like to be on a distributed system well before the end of Redstone. This will give us some time to work out the bugs before we “go public”. It will also allow performance testing and proof of concept demonstration.

If APIs were written to support different network systems, the HMF software could be used to compare NDDS or other COTS systems with the handwritten networking system. The model will be built to send 1 to 1000 packets per second on request.

Data Fusion and Data Health

Data fusion and data health for the HMF are in work as part of a rapid prototype effort. We hope for this to be available well before Redstone because our SL displays will look primarily at fused data.

System Model

I am developing a high-fidelity model of the hardware system using Matrix X. After working with Matrix X and Control Shell, I have recently come to the conclusion that Matrix X is a much better modeling tool. While Control Shell is probably better for finite state machines, it is much weaker on the data flow side. Models are almost exclusively data flow (raw calculations).

The model initially will simulate the FRCS helium system only. This model will run on a UNIX platform using the same APIs as the application software. The model will be available in time for the one box set. When we go to the distributed system, it will run on the back-up DDP and broadcast the data on the RTCN directly. This eliminates the need for a simulation gateway for now.

This model is a correct theoretical representation of the system. Unfortunately, this means that it is a serious "CPU hog". The helium system contains approximately 200 nodes (tanks or sections of pipe which are separated by valves, orifices, etc.). To correctly depict helium flow through small volumes, it is necessary to perform cyclic calculations of every flowrate and pressure at approximately 1 millisecond intervals. This means that the model will perform several million calculations per second. This may slow things down in the one box set. This is not expected to be a problem when the model is running by itself on the backup DDP in the SDE environment.

Application Software

The Redstone demonstration is intended to show all program types working together. We will not just have displays. We will have full command and control capability.

The software will be consistent with the published standard. There are a couple of additions to the software described in the standard. These are necessary to meet the intent of the requirements.

HCI Software:

The HCI displays will provide the interface to power up, cycle valves, and even select automatic control routines. The displays will be selectable from a main HMF FRCS menu. The system schematic type displays which allow us to monitor the system and cycle valves will be developed using SLGMS. They will be generally similar to present displays, although hopefully a little better.

An interface to sequencers is required which will provide data, status, and control. It needs to be able to analyze data, such as picking inflection points off of a curve. It also needs to be able to present the data. An example of this is a regulator flow. A data stream at 100 samples per second is analyzed during the flow. Six data points must be derived and compared to OMRSD requirements. A plot for the operator with all of the points labeled is needed. To meet these kinds of requirements, G2 is being used. It is a rule-based expert system tool. It has built in plotting capabilities and can easily do what I have described here. It has also been used by the Boeing Advanced Software group. Two programmers from this group are part of the HMF team.

A G2 display will come up when a sequencer is selected. It will act as the interface between the operator and the sequencer. It probably will issue operator requests to run, secure, or terminate a sequencer but will not be used to control hardware directly.

At least one or two (maybe more) SL displays and G2 programs will be present for Redstone.

CCP Software:

The CCP will contain an end-item manager which has all available methods for direct hardware manipulation. All commands will go through it. Displays will remotely kick off its methods. Sequencers will use its methods for all hardware manipulation. It will contain reactive control logic. It will implement prerequisite control logic by imbedding it in its methods.

The end-item manager will of course be present for Redstone.

Sequencers are being developed using Control Shell. They are event driven, and therefore map into the Control Shell implementation of a finite state machine very well. My expectation is that these will be kicked off concurrently by the CCP manager upon operator request.

We will have at least two or three sequencers for Redstone. They will perform functions such as pressurize a tank or perform regulator flows as previously described.

Summary

The HMF software pathfinder for Redstone will demonstrate command and control software on a distributed system. It will not be verified. It will be an application set in development. It will contain all program types but will not contain all planned displays or all planned sequencers. It is hoped that this set will show proof of concept for all planned functionality including the application software scheme, data fusion, data validity, and the underlying system.

3.3 Robust Web Interface Pathfinder

Overview - The Robust Web Interface supports the Graphical User Interface development for the CAP 104, 145, 134 and 135 applications which run on the SDC. The GUI will provide access to the CAP programs via the Business and Information Network on the Checkout and Launch Control System or an office workstation running a Web browser. CAP 104, 145, 134 and 135 are the initial CAP applications to be converted, others will follow after Redstone.

Statement of Work:

- Provide standard language and tool set for s/w development
- Provide a standard GUI for accessing CAP programs from the BIN and desktop workstations.
- Provide the infrastructure for Web based CAP GUI development.
- Provide Web interface to CAP 104 - General Purpose Test Support
- Provide Web interface to CAP 134 - LDB/Uplink Retrieval
- Provide Web interface to CAP 135 - Computer-to-computer Retrieval Programs
- Provide Web interface to CAP 145 - Retrieval Software for user graphics
- Provide DAP application server - interface between RWI and CAP programs residing on SDC
- Provide Web interface to DAP application main menu
- Update the Work Breakdown Structure (WBS)
- Provide performance data

4.0 Threads and CSCIs

4.1 Data Distribution Thread

Overview - The Data Distribution Thread supports end-to-end data flow of FDs. It provides the mechanism for the system to move data values between most elements of the CLCS, which include the DDPs, CCPs, HCIs, and the SDC. It supports retrieval of FD data by user applications and user displays.

Statement of Work:

- Provide performance data for system modeling.
- Confirm and or modify system data flow for FD Data Distribution.
- Provide the capability for the Data Distribution function to be utilized in both Operational and Application debug configurations.

DDP Data Merger Function

- Collect Gateway Change Data packets from all gateways at the system synchronous rate.
- Collect Application Change Data packets from all CCPs at System synchronous rate (No Application Change Data packets until Thor Delivery).
- Merge Gateway Change Data and Application Change Data in to a single a stream. (No Application Change Data until Thor Delivery).
- Merge health data into data element from health table.
- Place requested FDs in queues for the Data Fusion Function.
- Place requested FDs in queues for the Data Health Function.
- Place requested FDs in queues for the Data Constraint Function (Data Constraint Function is not part of Redstone Delivery).
- Transmit merged and transfer data at system synchronous rate on the RTCN.
- Transmit merged and transfer data at display synchronous rate on the DCN.
- Define and provide a method to send System Default Display Data Attribute Values. (A placeholder will be reserved in the CVT for default Display Data Attribute values. Setting mechanism will be defined for the Thor delivery).
- Maintain statistics on packet rates, data rates, and CPU utilization.

CCP Data Function

- Collect RTCN Change Data Packets from the DDP at system synchronous rate.
- Place requested FDs in queues for System and User Application.
- Provide an output queue for user Application Derived FDs and transmits them to the DDP at system synchronous rate. (No user Application Derived FDs to transmit in Redstone).
- Maintain statistics on packet rates, data rates, and CPU utilization.

HCI Data Function

- Collect DCN Change Data Packets from the DDP at display synchronous rate.
- Place requested FDs in queues for System and User Application.
- Maintain statistics on packet rates, data rates, and CPU utilization.

SDC Data Function

- For debug use – Record raw Gateway Change Data Packets from all gateways and Application Change Data Packets from all CCPs on the RTCN. (No Application Change Data Packets until Thor Delivery).
- Record DDP RTCN Data Distribution Packets in a format to permit FD Retrievals. Note: For Redstone this may require the data conversion to CCMS format, to support current retrieval software. The purpose is not to develop final record retrieval function.

Current Value Table Function

- Maintain in the DDPs, CCPs and HCIs a Current Value Table that contains for all FDs the current data value, its health and time of last change.
- Support all FD type including Time Homogenous and Multiword data.

Provide separation of data for different flow zones. (Added during kickoff meeting)

4.2 Data Fusion Thread

Overview - Data Fusion involves computations using constants, measurement values, health values or other fusion values. The result of the computation is a value which has a type equal to the data fusion Function Designator (FD) found in the CLCS Databank. Each fusion FD found in the databank has the same attributes that any other FD of the same type would have with the exception that a Fusion FD does not have a hardware record but does have a fusion algorithm table associated with it. The user may use the CLCS data Fusion Editor to aid in the input of the fusion algorithm and associated information.

The Data Fusion Thread establishes the CLCS capability to provide information using multiple FDs. This thread will support initial Data Fusion editing, loading, processing, distribution, system viewing, logging and retrieving.

Statement of Work:

- Define the list of logical and mathematical function required by the users for Data Fusion FD's.
- Define the list of logical and mathematical functions required by the users for Data Fusion Health.
- Define the Data Fusion FD types.
- Determine if a COTS tool can be utilized and provide the selected tool.
- Provide the initial Pre-build Data Fusion Editor.
- Provide the Data Fusion capability as part of the CLCS DDP Group.
- Provide the capability for Fused FD's to be utilized by the Data Distribution Manager for both the CCP and the HCI.
- Provide the capability to add fused FD's to the Data Bank.
- Provide the capability for Fused FD's in the Test Build process.
- Provide an initial System Viewer with the minimum capability to view Fused FD's., including the Fused FD value, associated input FD values and the function being used to generate the Fused FDs.
- Incorporate fused FDs into the record and retrieve capability with the same capability as Gateways FD's and User Application Derived FD's.
- Provide the capability for Fused FD's to be utilized by the Constraint Manager Function.
- Provide the capability for the Data Fusion Function to be utilized in both Operational and Application Debug Environments (e.g. DDP & HCI/DDP/CCP?GW/MM Logical Subsystems).
- Provide performance data for system modeling.
- Provide Capability to inhibit processing on individual Fusion FD's.

4.3 Data Health Thread

Overview - Data Health is based upon a number of parameters, some of which may be external to the system. Data Health is the term applied to the integrity of a Function Designator (FD) value which is being distributed from a CLCS subsystem. It consists of a group of flags which are associated with every FD. Each of the flags is "owned" by different processes within the CLCS system. For example, certain flags that deal with the de-commutation of the data from its source are "owned" by processes in the CLCS Gateway. Other flags are owned by processes which correlate various data to determine additional "health" information about one or more Function Designators. This information is available to all CLCS processes which utilize FD data.

The Data Health Thread establishes the CLCS capability to provide health information for FD's. This thread will support initial Data Path Health editing, building, loading, processing, and viewing. This thread will support initial Data Health loading, processing, viewing, logging and retrieving.

Statement of Work:

- Develop the Concept of Operations of how Data Health will be utilized by the User.
  - Define the list of Data Health requirements for both system processes and use processes.
  - Define the relationships between Data Health and other system processes such as Data Fusion.
- Define and then provide the Initial Pre-build Data Path Health Editor. The viewer will, for all health bits, display any reason information with input for multiple FD's.
- Define and then provide the Initial System Viewer capability for FD Health. The viewer will, for all health bits, display any reason information with input and internal values. The viewer will allow updates at a TBD request rate.
- Define the Databank impacts for Data Health and provide the capability to add Data Health and Data Path Health information to the Databank.
- Confirm and or modify system data flow for data health.
- Confirm and modify System Services for data health.
- Confirm and modify the Data Health Bits.
  - Provide for Gateway Provided status.
  - Provide for DDP generation health bits.
  - Provide for advisory and engineering inputs from CCP and HCI.
- Coordinate design with Data Distribution and Data Fusion
- Determine if a COTS tool can be utilized and implement the selected approach.
- Incorporate Data Health information into Data Distribution.
- Provide Initial record and retrieval capability
- Provide demonstration of at least one end to end GSE Analog health value.
- Provide performance data for system modeling.
- Provide the capability for the Data Health function to be utilized in both Operational and Application configuration.

4.4 GSE Support Phase 1 Thread

Overview - The GSE Support Thread establishes the initial capability to monitor and stimulate the CCMS format GSE link FD's. Recording, Retrieval, Databank, application services, display services, Data Distribution, System Build services and Test Build services will support basic CCMS format GSE FD's.

Statement of Work:

- Provide a GSE Gateway capable of polling a CCMS format GSE bus and providing Change Data Packets via the RTCN at the system synchronous rate (5-50msec).
- Provide the capability to detect GSE Bus and HIM Errors and update the FD Status appropriately.
- Provide the Test Build Services capable of supporting the initial GSE FD's, including GSE Gateway Table Generation and On-Line Databank Generation.
- Provide the capability to load/reload the GSE Gateway Tables in the Gateway.
- Provide the initial capability to record and retrieve the Initial GSE FD's via SDC.
- Provide the application services required to support display of the Initial GSE FD's.
- Provide the capability to issue basic Analog and Discrete stimulus on the CCMS format GSE link via a GSE Gateway.
- Define and support the GSE measurement FD's (AM, AS, DM, DS, DPM) for Redstone

4.5 Reliable Messages Phase 2 Thread

Overview - The Reliable Messages Phase 2 Thread is to complete the reliable delivery capability and to establish the logical communication and initial Message Writer capabilities of CLCS. This phase of the Thread will support development, loading, processing, distribution, system viewing, logging and retrieving of reliable messages. The Reliable Message System Service provides the capability for reliable messaging between CLCS Groups (e.g. CCP, DDP, HCI). Reliable Messages provides the following major capabilities for Redstone:

- Reliable Message re-transmission and status reporting
- Provide logical communication paths in support of Application Location Transparency
- Incorporate the COTS TYMSERVE NTP Server for network time synchronization
- Investigate/analyze network fault tolerance
- Provide performance measurements and data for system modeling
- System Messages distribution recording, retrieval and display
- Assess recording of IPCs and other data types

Statement of Work:

- Reliable Message (RM) Services shall take the following actions as necessary to ensure reliable message delivery:
    - Retry (Duplicate - see next statement)
    - Automatic request re-broadcast when a numbered packet is missed
        - Provide re-transmission of the data messages to end stations registered for reliable message communication participation.
        - Re-transmission of the current data message shall complete or time-out prior to transmission of the next message received from the sending application.
- Report failed attempts and repeated retries via system messages and allow the retry count to be set per type to any number (1 to n). (Duplicate - see next statement)
- Report repeated broadcast retries via system messages.
    - At a minimum, failed attempts and repeated retries shall be reported via the System Message Service.
    - The number of data message transmission retries shall be statically configurable per data stream type (Note: Entries will be procedurally controlled to prevent exceeding the system data transmission time limitations)
- Abort message delivery attempt if a user specified time-out occurs.
    - Message delivery attempts by the sender shall be aborted based on a configurable expiration timer set for acknowledgment responses.
- Provide automatic sequential numbering of data packets by type.
    - Provide automatic sequential numbering of data packets based on stream or port connections
- Maintain a recent history of data broadcast packets by type.
    - The RM shall contain the capability to receive and buffer the next application message(s) until the current message is transmitted, re-transmitted or aborted.
- Provide logical communication between CLCS Groups with local or remote routing being transparent to the caller
- Provide the Reliable Message Functions required to support both the Operational and Application configurations (e.g. DDP & HCI/DDP/CCP/GW/MM Logical Subsystems).
    - Network Services shall provide logical communications such that applications on the same platform can communicate transparently as if they were remote on the network. This is in support of CLCS Application Groupings or Location Transparency onto a single platform.
- Provide performance data for system modeling.

SYSTEM MESSAGES:

- Define and implement the Packet Payload Format for System Messages
- Each System Message shall contain the following minimum contents:

    1. Source - Application Name
    2. Message Number
    3. Severity Level (e.g., Information, Warning, error)
    4. Message Group or category (e.g., RSYS, Redundancy Management, HW, GSE)
    5. Message Parameters Note: Multilevel groups will be required. For Example:
        - LOX: Major Event
        - RM: Switch..

- At a minimum, the System Message Services will:

    1. Allow the user to subscribe to one or more categories,
    2. Display the System Message Number and Text with the parameters filled in,
    3. Hide the System Message "Details" and Help until requested by the user,
    4. Provide a mechanism to group the messages by (multilevel) Message Group,
    5. Provide standard display paradigm,
    6. Provide a Standard Human Factors Interface paradigm,
    7. Provide a standard color scheme such as Severity, acknowledged, and unacknowledged messages,
    8. Provide for single and multi-line messages,
    9. Provide the capability to acknowledge messages individually and as a group.

- Each System Message will be time stamped.
- The System Message capability will provide the ability to select and deselect audible alarms.
- The System Message capability will provide the ability to turn off an audible alarm.
- Messages are displayed in outline form, graphically by Message Group.
- A summary is provided by Message Group which depicts message count by Severity and displays an indicator showing messages that have not been acknowledged for each level of severity.
- The user can clear or acknowledge messages singly, by Message Group, and Severity or in groups (i.e., by highlighting the group and then acknowledging)
- When a user registers for a new Message Group recent (TBD) messages will be displayed for the Message Group.

GROUNDRULES:

The System Message Catalog and Help Information will be created by tools in the System Build
The System Message Text and help will not be transmitted with every message across the system.

New and JUNO Requirements not in the SOW:

- Perform error checking (i.e. CRC, checksum) to reliably transfer data
- Provide application access to reliable multicast registered information and the current status of receiver acknowledgments.
- Incorporate the COTS TYMSERVE NTP Server for IRIG B network time synchronization.
- Assess recording and retrieval of IPCs and other data types.
- Investigate/analyze network fault tolerance.

4.6 Simulation Interface to RTCN Thread

Overview - The Simulation Interface to the RTCN Thread purpose is to provide the capability to connect the SGOS Math Models to the CLCS RTCN without the use of front end gateways or VSI equipment.

Statement of Work:

- Provide one each Simulation Gateways for a connection to two (2) SDEs and one (1) IDE (i.e., a total of three (3) gateways).
- Provide a network or equivalent interface between SGOS Simulation and the Simulation Gateway.
- Provide for the conversion of GSE, PCM, and SSME measurement values to Gateway Change Packet Formats.
- Provide for the stimulation of the model GSE Analogs and Discrete stimulus by way of CCP Command Request Packet(s) from the RTCN
- The Simulation I/F to RTCN will provide only the conversion of GSE measurement values to Gateway Change Packet Formats.
- The Simulation I/F to RTCN will provide for the stimulation of only the HMF model's GSE Analog and Discrete stimuli.

4.7 Super Light Weight Tank Monitor Thread

Overview - The Super Lightweight Tank (SLWT) Monitor Thread's purpose is to demonstrate the capability of the CLCS System (from gateway to HCI) using display monitor applications for the Shuttle vehicle/GSE systems involved in the SLWT Test. The major system functions to be demonstrated will be the display function capability using the SL-GMS dynamic data visualization tool, data health, data fusion, data distribution and the consolidated systems gateway.

Statement of Work:

- Define and implement the Users Displays to support the SLWT test.
- Define and implement the demonstration data fusion FDs (and their algorithms) required to support the SLWT test.
- Define the GMS/Metro unique FDs and provide the system and application services to support them for the SLWT test.
- Demonstrate data health as it relates to the SLWT user display FDs.
- Define and implement the demonstration FDs health required to support the SLWT test.
- Develop the Concept of Operations for support of the SLWT test.
- Define and provide the hardware requirements for supporting the SLWT test (including OIS, OTV, etc.).
- Provide an updated Basis-Of-Estimate for the display development effort for all Application Software Sets.

4.8 System Build & Load Phase 1 Thread

Overview - System Build & Load Phase 1 thread provides the capability to build and load OS and System Software from the Master CM repositories onto the CLCS test and operational sets. This capability is independent of Test builds yet must support multiple Test builds. This capability also provides a method for identifying repeatable System Builds called a System Configuration Identifier (SCID). The SCID, and its revision number, is a repeatable collection of products that support multiple Test builds (TCIDs) on a particular set configuration. This set configuration ranges from a set used for Application Debug, to a partially operational set which may be used for test and integration, and finally to a fully operational set.

Statement of Work:

- This capability will build and load the OS baseline software onto the CLCS Subsystem Hardware.
- This capability will provide a means of identifying a combination of Subsystem Loads as an SCID. A Subsystem Load is comprised of all the System Software required to operate the CLCS Subsystem Hardware (i.e. DDP, CCP, DDP/CCP, DDP/CCP/HCI, HCI, Gateway).
- This capability will provide a mechanism for building an SCID (i.e. compile/link).
- This capability will provide a mechanism for loading one or more SCIDs onto the OPS CM server.
- This capability will provide a mechanism for loading an SCID onto the CLCS Subsystem Hardware from the OPS CM server.
- This capability will provide a mechanism for maintaining multiple SCIDs on an OPS CM server.
- This capability will provide a mechanism for updating an SCID on an OPS CM server.
- This capability will provide a mechanism for initializing System Software on Subsystem Hardware.

The following requirements are levied on this thread in order to complete JUNO's CM shell requirements.

- This capability will provide a CM shell able to implement role based functional groups for use by the CM protection scheme, the object promotion scheme, and the build/load capabilities.
- This capability will provide a CM shell capable of supporting automated SCID/TCID builds.
- This capability will provide a CM shell for CLCS online document management.
- This capability will provide a CM shell able to implement CLCS change tracking.
- This capability will provide a CM shell that is accessible from the Office PCs and the CLCS development workstations.

4.9 Test Build, Load & Activation Phase 1 Thread

Overview - Test Build, Load & Activation will provide the following capabilities for Redstone:

- TCID Build products required to support Redstone demonstration capabilities
- The ability to load a Target CLCS Set with required TCID Build products and application products
- The ability to bring a Target CLCS Set to an active state

Statement of Work:

- Determine whether Test Build should produce memory image tables or an interim form from which memory image tables are created at CLCS Subsystem load/initialization.
- Integrate Test Build & Load services with the CLCS Development Environment and the SDC.
- Provide GW Tables.
- Provide the Online Data Bank Table.
- Provide a Function Designator Directory Table.
- Provide user application files organized by responsible system.
- Provide an initial capability to load and activate a Test Build onto a CLCS Set.

4.10 User Commanding Phase 1 Thread

Overview - The User Commanding Thread for the Redstone delivery provides initial capability for demonstrating basic User Commanding capability in two environments:

- End-to-End demonstration (HCI-to-HIM) of GSE Analog and Discrete commanding
- Demonstration of user display capability to control GSE Analog and Discrete Stimulus in the Application Debug Configuration Thread.

Additionally, the User Commanding capability will support the application debug development and the RTCN Simulation Thread.

Statement of Work:

- Provide the capability to send command stimulus from an HCI display.
- Develop user interface methods for cursor commands and upgrades to selected display tool to provide cursor stimulus.
- Develop an initial user interface for manual User Commands.
- Provide capability to send commands from the CCP.
- Provide the capability for User Commanding function to be utilized in both Operational and Application Debug Environments.
- Provide initial System Application and Application Services:
    - In the CCP, receive a HCI request, format it and forward it to a Gateway.
    - In the CCP, receive a Gateway response, format it and forward it to a HCI
    - In the Gateway, send Feedback FDs in Data Change packets to the Data Distribution Function.
- Provide a user display capability to control GSE Analog and Discrete Stimulus.
- Develop Packet formats and content.
- Provide a demonstration of the above user display in the Application Debug Configuration.
- Provide a demonstration of end-to-end (HCI-to-HIM) GSE Analog and Discrete commanding.
- Provide the capability for two-step command confirmation on the HCI platform (added to SOW at DP1 Internal Review).

4.11 User Display Monitor and Plotting Thread

Overview - The User Display Monitor and Plotting thread supports monitor-only user display application development and processing on the Checkout and Launch Control System (CLCS) Human Computer Interface (HCI) Workstation. It also provides a path-finding demonstration of extensions to the selected dynamic data visualization tools (DDVT) to support advanced data plotting features such as those provided by a PCGOAL Workstation.

Statement of Work:

The User Display Monitor and Plotting Thread is expected to accomplish the following work in the Redstone time frame (the following lists are re-prints of the Statement of Work for Redstone; derived requirements are given at the end.):

User Display Monitor:

- Validate feasibility of current choice of SL for user display tool. If SL is not tool, provide trade study of COTS and custom solutions.
- Provide a strategy for use of display tool.
- Provide the foundation building blocks for display development by users.
- Provide at least one screen for selected Responsible System (RSYS) (with support from the RSYS Engineer) on the selected tool as a user display pathfinder.
  a) Provide a user evaluation report of selected display tool.
  b) Document manpower to train and build displays.
  c) Update the Work Breakdown Structure (WBS) Basis Of Estimate (BOE).

- Provide upgrades to perform the following for each data point:
  d) Interface and selection for plotting.
  e) Interface display tool to Function Designator (FD) Status Information display.
  f) Interface to System Viewers (Interface only).

- Provide interface to FD CLCS data and health.
- Provide performance data for display startup time, values displayed per second, and CPU utilization.
- (Derived): Provide a capability to deliver the software to the LCC-X environment in a controlled manner.

Plotting Pathfinder:

1. Evaluate various plot services, both COTS and custom.
2. Provide real-time plotting of up to a minimum of 6 concurrent measurements on the same scale (for example, 2 measurements for each of 3 engines).
3. Provide for time scales zoom or zoom out under mouse control from 8 hours to 10ms
4. Provide an interface that allows FDs to select by cursor on user displays to be plotted.
5. Provide for adjustment of gain scale under mouse control.
6. Provide forward and backward movement in time.
7. Provide for display of both countdown and GMT time.
8. Provide support for Ground Support Equipment (GSE) Analog, GSE Discrete, and Super Lightweight Tank (SLWT) FDs.
9. Integrate plotting function with the CLCS data streams.
10. Provide a demonstration and a user evaluation.
11. Provide performance data for display startup time, CPU utilization and plotting performance data.
12. Provide a hard-copy capability.

4.12 Consolidated SDS CSCI

Overview - The consolidated SDS Thread is continuation of developments activities that were completed in JUNO. For Redstone, the Consolidated SDS Gateway will be transitioned to LPS Operations to Support launch activities in the Fall/Winter 1997-98.

Statement of Work:

- Provide two Consolidated SDS Gateways to LPS Operations.
- Develop Validation Plans.
- Develop Transition Plans.
- Perform Validation activities.
- Develop Operations Procudures.
- Develop all other required documentation.

4.13 Consolidated System Gateway CSCI

Overview - The consolidated System Gateway Thread is continuation of developments activities that were completed in JUNO. For Redstone, the Consolidated Systems Gateway Test Data Generator will be updated to support the Redstone RTCN Packet Format.

Statement of Work:

- Update Consolidated Systems Test Data Generator Software to conform to Redstone RTCN Packet Format
- Deploy new Software in SDE 1, SDE 2, and IDE 1.
- Deploy a Consolidated Systems Gateway at the SDE-JSC in Houston.

5.0 Redstone Delivery System Software CSCI Impacts

Key: X = Impact or Dependency

CSCI	**CSC**	**Function**	Data Fusion	Data health	Data Dist	Displ.-Plotter	Com-mand	GSE Link	Rel. Mes-sages	Sim Gate way	System build	Test Build	SLWT	Debug
System Services														
	Operating System				X			X		X	X			
	Access Control/Security										X			
	Network Services		X		X				X					
		Interprocessor Communications	X				X		X					X
		Data Logging	X		X				X					X
	Timer Services		X	X	X	X	X							
	Utility Services				X	X	X							
Application Services														
	Constraint Management Services													
	End Item Manager Services													X
	FD Services		X	X	X	X	X	X					X	X
	Inter-Application Communications						X							X
	On-line Data Bank		X	X	X	X	X	X						X
	Test Application Script Services													X
	User Display Services					X	X	X					X	X
Applications Support Tools														
	Dynamic Data Visualization Tool (Run Time)					X	X						X	
	End Item Manager (Run Time)													X
	Prerequisite Control Logic (Run Time)													
	Test Application Script (Run Time)													
	Regression Test Tool													
Data Distribution & Processing														
	Time Reordering				X									
	Change Checking				X									
	Data Distribution		X	X	X			X						
	Data Health		X	X	X									
	Data Fusion		X	X	X									
	Constraint Management													
User Application Processing														
	End Item Manager Processing													

CSCI	CSC	Function	Data Fusion	Data health	Data Dist	Disply-Plotter	Com-mand	GSE Link	Rel. Mes-sages	Sim Gate way	System build	Test Build	SLWT	Debug
	Prerequisite Control Logic Processing													
	Test Application Script Manager Processing													
System Viewers														
	Constraint Viewer												X	
	FD Viewer		X	X	X	X							X	
	FD Monitor		X	X	X	X							X	
	System Message Writer			X		X	X	X	X					
	Test Applications Script Viewer													
	Others													
Command Processor														
	DEU Equivalent Processing													
	Gateway Control							X						
	Gateway Table Maintenance													
	Issue Commands						X	X						X
	Others													
System Control								X						
	Redundancy Management							X	X					
		System Integrity												
		System Advisory Services												
		Subsystem Health												
	Ops Configuration Manager						X							
		RTPS System SW Load and Initialization									X	X	X	
		Test Load	X	X	X		X	X				X	X	
		System Verification												
System Diagnostics														
	On-line Readiness Test													
	RTPS Performance/Capacity Analysis								X					
Common Gateway Services								X	X	X				X
Consolidated System Gateway Services										X				X
GSE Gateway Services							X	X		X				X
LDB Gateway Services										X				
PCM D/L Gateway Services										X				
Uplink Gateway Services										X				

CSCI	CSC	Function	Data Fusion	Data health	Data Dist	Disp.-Plotter	Com-mand	GSE Link	Rel. Mes-sages	Sim Gate way	System build	Test Build	SLWT	Debug
Consolidated Sys G/W					X									
Simulation Gateway										X				X
CLCS Developmen t Environment														
	CM Repository										X	X		
	Development Environment (Shell)										X	X		
		Administrative Services									X	X		
		Tool Services									X	X		X
		Build Services									X	X		X
		User/Function Management									X	X		X
		Regression Test Services									X			X
	Application Editors & Compilers (IIS)										X			
		C/C++ Compilers									X			
		Data Path Editor/Compiler		X								X	X	
		Data Fusion Editor/Compiler	X									X	X	
		End Item State Machine Editor/Compiler												
		TCS-S Compiler												
		Test Application Script Editor/Compiler												
RTPS Sys SW Build														
	OS Build										X			
	Subsystem Build			X							X			
DB Safe												X		
TCID Build & Control														
	Directory Build		X	X								X		
	Table Build		X	X				X		X		X	X	X
	On-Line Data Bank Build		X	X	X			X		X		X	X	X
	Build Utilities		X	X										X
		Load Checker												
		Cross Reference (IIU)												
		TCS-S Configuration												
Data Recording & Archival			X	X	X	X		X	X			X	X	X
Data Retrieval					X			X				X		
SDS Services														
	SDS Client Services													
	SDS Server Services													

Acronyms

	- A -
ATM	Asynchronous Transfer Mode
ANSI	American National Standards Institute
	- B -
BFL	Block Funnel Logged
	- C -
CCMS	Checkout, Control, and Monitor System
CCP	Command and Control Processor
CCS	Complex Control Set
CCC	Complex Control Center
CDBFR	Common Data Buffer
CEA	Common Equipment Area
CI	Configuration Item
CITE	Cargo Integrated Test Equipment (Set)
CLCS	Checkout and Launch Control System
CM	Configuration Management
COTS	Commercial Off the Shelf
CPU	Central Processor Unit
CRMP	Command and Real-Time Monitor Position
CRT	Cathode Ray Tube
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
	- D -
DCN	Display and Control Network
DDP	Data Distribution Processor
DFRC	Dryden Flight Research Center (Set)
	- E -
EDL	Engineering Development Laboratory
	- F -
FD	Function Designator
FDDI	Fiber Distributed Data Interface
FEP	Front End Processor
	- G -
GSE	Ground Support Equipment
GMS	Ground Measurement System
GOAL	Ground Operations Aerospace Language
	- H -
HCI	Human Computer Interface
HOSC	Huntsville Operations Support Center
HMF	Hypergol Maintenance Facility (Set)
HUMS	Hydrogen Umbilical Mass Spectrometer
HWCI	Hardware Configuration Item
	- I -
IDE	Integrated Development Environment
I/O	Input/Output
IPR	Interim Problem Report
ISO	International Standards Organization
	- J -
JSC	Johnson Space Center
	- K -
KATS	Kennedy Avionics Test Set
Kb	Kilo-bit
Kbs	Kilo-bits per second
KB	Kilo-Byte
KBS	Kilo-Bytes Second
KSC	Kennedy Space Center
	- L -
LACD	Local Acquisition, Command, and Display Subsystem
LCC	Launch Control Center
LCC	Launch Commit Criteria
LDB	Launch Data Bus
LO_2	Liquid Oxygen
LH_2	Liquid Hydrogen
LPS	Launch Processing System

LS	Launch Sequence
	- M -
Mb	Mega-bit
Mbs	Mega-bits per second
MB	Mega-Byte
MBS	Mega-Bytes Second
MDM	Multiplexer/Demultiplexer
MER	Mission Evaluation Room
MFR	Multi-function Room
MM	Mass Memory
MSec	millisecond(s)
	- N -
NASA	National Aeronautics and Space Administration
	- O -
O&M	Operations and Maintenance
OCR	Operations Control Room
OIS	Operational _____, also OI Standby (FEP)
OPF	Orbiter Processing Facility
OTV	Operational Television
OV	Orbiter Vehicle
	- P -
PCC	Processing Control Center
PCM	Pulse Coded Modulation
PFP	Programmable Function Panel
PRACA	Problem Reporting and Corrective Action
	- Q -
	- R -
RADS	Remote Acquisition and Display Subsystem
RON	Restricted Operational Network
RTCN	Real-Time Critical Network
RTPS	Real-Time Processing System
	- S -
SAIL	Shuttle Avionics Integration Lab (Set)
SACS	Systems Software Avionics Command Support
SCT	System Configuration Table
SDC	Shuttle Data Center
SDE	Satellite Development Environment
SDS	Shuttle Data Stream
SECAS	Shuttle Engineering Computer Application System
SIMS	Still Image Management System
SLP	SSME Load Program
SLS	System Level Specification
SRB	Solid Rocket Booster
SSPF	Space Station Processing Facility
STS	Shuttle Transportation System
	- T -
TCID	Test Control Identifier
TCS	Test Control Supervisor
TCS-1	Test Control Supervisor - one for one command
TCS-S	Test Control Supervisor - Test Sequence
TRE	Test Resource Equipment
	- U -
	- V -
VP	Vehicle Processing (Set)
VPF	Vertical Processing Facility
	- W -
	- X -
	- Y -
	- Z -

Glossary

Application — An application is a computer software program, or set of programs, written to perform a specific task (e.g., MS Word, MS Power Point, CCMS Ground Launch Sequencer).

Business and Information Network — The Business and Information Network is a network of communications paths, computers, computer programs, and information that is external to the CLCS. CLCS provides connectivity and access to this external network.

Cargo Integrated Test Equipment — The Cargo Integrated Test Equipment (CITE) Sets are located in the Space Station Processing Facility (SSPF) and Vertical Processing Facility (VPF) are used to integrate and test payloads prior to them being loaded into the Orbiter.

Terminology Issue still. LPS/CLCS, CCMS/????, SDC/PDRSPA

CDBFR Counts — CDBFR counts are count values resident in the CDBFR. These counts are left justified within the CDBFR word. All CDBFR counts are assumed to be linear, bipolar, 2's complement, big-endian integer values. CDBFR count values can be up to 16-bits long. This terminology is new and is introduced to clarify the distinction between right justified processed counts and left justified CDBFR counts.

CDBFR Length — The CDBFR length of a measurement is the number of CDBFR bits required to represent the measurement in CDBFR counts. For example, the CDBFR length of an 8-bit unipolar GSE measurement is 9; 1 sign bit plus the 8 unipolar magnitude bits (remember that CDBFR counts are always assumed to be bipolar, thus a sign bit must be added to unipolar measurements by the FEP). The CDBFR length of a 10 bit bipolar PCM measurement is 10; the sign is already part of the raw data and does not have to be added. CDBFR lengths range from 2 to 32 bits.. Since the CCMS CDBFR uses 16-bit words, any measurement with a CDBFR length > 16 requires two CDBFR locations

CDBFR Size — The CDBFR size of a measurement is the total number of CDBFR bits being used to hold the measurement. In CCMS, single word analogs (AM) reside in a single CDBFR location, thus the CDBFR size is 16. Multi-word analogs (AMDP) reside in two CDBFR locations, thus the CDBFR size is 32.

CLCS SDS — The CLCS Shuttle Data Stream (SDS) is the CLCS equivalent of the current Shuttle Data Stream.

CLCS Set — The collection of equipment in a physical facility that is interconnected and dedicated to performing a major function or task (e.g., CITE is used for Payload Integration and Checkout). The equipment contained in a CLCS set consists of the equipment contained in Flow Zones, Control Zones, Front End Zones, and associated Networks (RTCN, DCN, & RON). Currently the following CLCS Sets are defined:

- Vehicle Processing (VP) Set
- Cargo Integrated Test Equipment (CITE) Set
- Complex Control (CCS) Set
- Hypergol Maintenance Facility (HMF) Set
- Dryden Flight Research Center (DFRC) Set
- Kennedy Avionics Test (KATS) Set
- Shuttle Avionics Integration Lab (SAIL) Set
- Development Sets
  - Integrated Development Environment
  - Satellite Development Environments

Note: Some of the above CLCS Sets are only candidate sets at this time.

Command and Real-Time Monitor Position —

Common Data Buffer — The CCMS system contains a shared memory called the Common Data Buffer (CDBFR). The CDBFR contains the current status of all measurement data, the current status of all subsystems in the set. All messages are also transmitted through the CDBFR.

Common Equipment Room — The Common Equipment Room contains the FEZs, CZs, RTCN, and DCN equipment for the VP set. The Common Equipment Room is the back rooms of the OCRs and MFR.

Complex Control Set — The Complex Control Set is located in the LCC at the Kennedy Space Center. It is used to monitor and control facilities equipment at KSC.

Console — This term is used exclusively to describe the existing 3-bay housing in the current LPS system.

Console Back Row — This term is used exclusively to describe the existing set of MODCOMP computers, tables and PCGOAL workstations that reside behind the Consoles in the current LPS system.

Console Position — A CLCS Console Position is analogous to a bay in the LPS Console. The CLCS Console Position will contain all the necessary workstations, hardware, peripherals and connectivity required (e.g., OIS-D, OTV, Safing, Applications Software Access, Business System s Access, etc.) for a pair of users. The systems of many of the existing LPS Consoles will require three CLCS Console Positions. With Console Positions, sharing of Consoles by different systems will be reduced.

Console Support Module — A CLCS Console Support Module provides the necessary table space, hardware and connectivity to allow for three additional users to comfortably support operations taking place at a CLCS Console Position.

Constraint Management — CLCS provides the capability to monitor measurement and fused data for a predetermined condition and notify personnel operating the TRE and other software applications executing within the TRE that the monitored data no longer meets the predetermined condition. This capability is called constraint management.

Converted Counts — Converted counts are raw counts that have undergone subtype-dependent processing in the FEP to isolate and position count data within a data word. Examples of subtypes that require processing are Binary Coded Decimal (BCD), TACAN Bearing (TAB), BIT String Magnitude (ASM), and Halfword Overflow Signed (AOS). Other than the fact that converted counts have had some “conversion processing” performed, these counts are similar to raw counts, i.e., they are right justified, bipolar, 2’s complement, big-endian integer values. This terminology is new and is introduced to clarify the distinction between right justified raw counts and right justified processed counts.

Control Zone — The portion of a CLCS Set that contains the heart of the computational capability of the set. The Control Zone consists of the Data Distribution Processors, Command Control Processors and CM Server(s).

Data Fusion — Data fusion is the process of combining measurement data and other CLCS system parameters into a higher level of information. The process for combining data may include algebraic and logical manipulation of data and conditional testing of system parameters or intermediate calculated values. The combined or “fused” data is a CLCS function designator.

Data Health — The combination of gateway status for each item of data and user defined status for the data item.

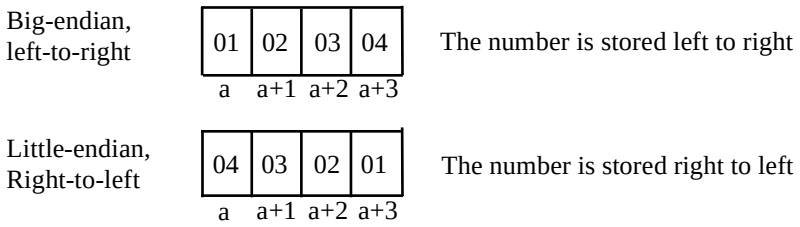
Data Status — The portion of data health that relates strictly to the status of the data item as determined by the gateway (e.g., a measurement who’s status indicates it isn’t being updated because it isn’t in the current PCM format).

Data Validity — Data Validity is a term used to describe whether or not measurement data is valid at a given point in time. Many of the measurements acquired from the STS are not present in all PCM formats and thus the value of the measurement is either not known or the last known value is no longer valid.

Derived Measurement — A Derived Measurement is one which has been created by the process of data fusion.

Dryden Flight Research Center Set — The Dryden Flight Research Center (DFRC) Set is located at the Dryden Flight Research Center in California. The DFRC Set is used to monitor and control _____

Endian Architecture — When several bytes are required to store data, computers differ in which byte of storage they consider to be the “first”. In “right-to-left” or “little-endian” architecture, which include the Intel 80x86 and Pentium microprocessor, the address of a 32-bit integer is also the address of the low-order byte of the integer. In “left-to-right” or “big-endian” architectures, which include the Motorola 680x0 microprocessor family, the address of a 32-bit integer is the address of the high-order byte of the integer. Consider the number 1234 that is stored in addresses a through a+3:



Engineering Units — Engineering units are the representation of the measurement in the units understood by the user (e.g., volts, PSI, feet per second, etc.). Floating point numbers are used to represent engineering units. The engineering unit range depends on the type of hardware transducer.

Flow Zone — A group of consoles positions configured to support a particular test. Within an OCR, 1 or more flow zones can exist and will fluctuate according to the test configurations.

Fractional Counts — Fractional counts are a floating point "interpretation" of CDBFR counts that assumes an implied binary point exists to the right of the sign bit. Mathematically, then, fractional counts range from -0.5 to +0.5. CCMS console software converts CDBFR counts to fractional counts prior to scaling.

Front End Zone — The data acquisition equipment and other interface devices which are attached to the links to a particular place (i.e., Station Set).

Function Designator — Function Designator is the name given for item which defined externally to where it is used. This term is slightly different in LPS and CCMS. The two definitions follow:

1. LPS — A Function Designator identifies by name items which are external to a GOAL procedure. Function Designators are normally defined in the data bank and refer to hardware measurements, commands, or system elements. However, some FDs are defined in GOAL procedures for use as a Pseudo Parameter of a program.
2. CLCS — A Function Designator is a name given to items which are defined in one place, such as the data bank, and may be referred to anywhere within the CLCS System.

Hypergol Maintenance Facility Set — The Hypergol Maintenance Facility (HMF) Set is located in the industrial area at the Kennedy Space Center. The HMF Set is used to monitor and control Hypergolic equipment from the Orbiter that is being reconditioned and refurbished for reuse.

Integrated Development Environment Set — The Integrated Development Environment (IDE) Set is located in the PCC at the Kennedy Space Center. The IDE is used for integration and test of the CLCS Application SW with CLCS Hardware and System Software.

Kennedy Avionics Test System Set — The Kennedy Avionics Test System (KATS) Set is located at the Kennedy Space Center. The KATS Set is used to monitor and control _____

_____

Linearization — Signal non-linearities are introduced into analog measurements by signal conditioners and transducer non-linearities. The CCMS system assumes that the analog data, which is stored and processed from the CDBFR, exhibits a linear relationship between the signal (in counts) as recorded in the CDBFR and the actual signal fluctuation as measured by the transducer. A method of accounting for this non-linearity was implemented in LPS. The capability, was provided, to associate line segment approximations of the calibration data curve with an analog measurement. The linearization curve is approximated by the use of one or four line segments. Each line segment has a K1 (slope) value and a K2 (Y-intercept) value which constitutes the standard equation for a line.

Local Operations — Local Operations are those that are performed in the vicinity of the actual hardware.

Logged Data — Data that is sent to the recording system to be recorded. This data is equivalent to LPS Block Funnel Logged (BFL) data in LPS.

Multi-Function Room — The Multi-Function Room (MFR) is built in one of the rooms which was formerly a KSC Launch Control Center (LCC) Firing Room. The MFR contains the CLCS Console Position Equipment used for Shuttle Horizontal Processing

Operations Control Room — Operations Control Rooms (OCR) are built in rooms which were formerly KSC LCC Firing Rooms. They contain all of the Console Position Equipment and Shared I/O Equipment used for both horizontal and vertical STS processing and STS Launches. The back room portion of the OCRs and MFR contain the Common Equipment.

Processed Counts — Processed counts are raw counts that have undergone subtype-dependent processing in the FEP (i.e., converted counts). Processed counts have been linearized by the FEP using line segment data from its' tables, if the measurement requires it, and are bipolar, 2's complement, big-endian integer values. The LPS "definition" of this term is vague and imprecise, at times meaning right justified counts, and at other times meaning left-justified counts (see CDBFR counts).

Raw Counts — Raw counts are the count values as received from the hardware. These counts are right justified. Raw counts are represented by an Integer value whose range depends on the measurement length. The normal count range for an 8-bit unipolar GSE measurement is +3 to +253. A 10 bit PCM bipolar measurement ranges from -512 to +511.

Real-Time Processing System — The Real-Time Processing System (RTPS) consists of FEZs, CZs, and FZs. This equipment performs the real-time processing for CLCS.

Reduced Capability Mode — A mode of the CLCS in which all normal functionality defined for the TRE is not present. This mode may be entered in a number of ways.

Shuttle Data Center —

Shuttle Data Stream —

Shared I/O Area — The area in and Operations Control Room (OCR), Multi-Function Room (MFR), or Specialized Processing Site containing printers, plotters, and other devices that are shared by multiple users in the control area.

Shuttle Avionics Integration Lab Set — The Shuttle Avionics Integration Lab (SAIL) Set is located at the Johnson Space Center in Texas. The SAIL Set is used to verify CLCS SW in the avionics integration environment at SAIL.

Simulation System —

Satellite Development Environment Set — There are two types of Satellite Development Environment (SDE) Sets.

1. The System Software SDEs (2 ea.) will be located close to the System Software developers, initially in the Engineering Development Laboratory (EDL) then in the Processing Control Center (PCC). The SDEs are used to develop, unit test, and integrate CLCS System Software prior to integration at the IDE.
2. The Application Software SDE is located in the PCC building at Kennedy Space Center. This set is used to develop, unit test, and integrate CLCS Application Software prior to integration at the IDE.

Station Set — A Station Set is a facility and all of its equipment (e.g., OV 104, Pad A, High Bay 1, OPF 1).

System Software Build — The process of creating software that is ready for loading into the RTPS subsystem computing equipment.

Test Build — The process of creating the test environment specific data, tables, etc., and preparing this information for loading into a TRE.

Test End Item — Test End Item is a term which is used interchangeably with Station Set.

Test Resource Equipment — A group of CLCS RTPS Subsystems and networks configured for a test. Typically a TRE will include one or more Gateways within a single Front End Zone, some portion of an RTCN's bandwidth, one or more DDPs and CCPs within one or more Control Zones, some portion of a DCN's bandwidth, and one or more Console Positions in a Flow Zone. This entire set of equipment would constitute a Test Resource Equipment. A Launch configured TRE would include all the Gateways in that Pad's Front End Zone, an pair of isolated RTCNs, two Control Zones with several DDPs and a larger number of CCPs utilized, the DCN within that OCR, and all the Console Positions in that OCR.

Vehicle Processing Set — The Vehicle Processing (VP) Set consists of all of the CLCS equipment in the OCRs and MFR of the LCC at the Kennedy Space Center. This equipment is considered to be one set because subsets of the equipment may be configured into many different TREs and connected to different station sets at any given time.

Workstation — A desktop computer. In a CLCS OCR a workstation is a desktop computer utilized in a CLCS Console Position or Console Support Module. There are two kinds of workstations in CLCS:

1. Workstations for executing CLCS applications and viewing CLCS displays. This workstation could have more than one monitor.
2. Workstations for business systems connectivity to access on-line documentation and historical log books, generate deviation paperwork (e.g., IPRs, PRACA, Deviation Records) and to provide connectivity to center-wide and world-wide information